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Editorial

Movement forward: The continued growth of Child–Computer Interaction research

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ABSTRACT

In this inaugural editorial as the new and the past editors-in-chief of the International Journal of Child-Computer Interaction (IJCCI), we take stock of the journal's progress in its first 8 years of existence, and we describe our views and plans to support the journal maintain its positive trajectory as the premier journal *in the multidisciplinary area of Child-Computer Interaction (CCI) and Interaction Design and Children*, and a respected and leading journal in the fields of human–computer interaction, interaction design (IDC) and the learning sciences. Here we take the opportunity to lay out a vision for the upcoming years as well as to reflect and engage in a constructive and critical dialogue about the future of CCI as a field of research and the IJCCI.

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1. Introduction

We have been following and supporting the International Journal of Child-Computer Interaction (IJCCI) ever since its inception in 2013. We firmly believe that IJCCI addresses an important need in the research community, namely, the need for a top-quality journal in which to publish rigorous research on Child-Computer Interaction (CCI). CCI is a multidisciplinary area of scientific investigation that concerns the phenomena surrounding the interaction between children and computational and communication technologies [1]. The CCI research community combines inputs and perspectives from multiple scientific disciplines informing and supporting an area of research and industrial practice that concerns the design, evaluation, and implementation of interactive computer systems for children, and the wider impact of technology on children and society [2].

CCI is a field that is continuously evolving and growing [3], so it is important to engage within a constructive and critical dialogue with contributors and readers, and members of the CCI research community-at-large, about the future of our work. The unprecedented events of 2020 will have a reverberating effect on CCI research for many years to come. The global pandemic is accelerating the adoption of technology and virtual learning environments in schools, while at the same time amplifying structural systems within our societies that have marginalized and oppressed children and their families along lines of race, ethnicity, class, and gender. At the same time, the impacts of global climate change are unrelenting and will bring to the fore issues of migration, food security, armed conflict, and natural disaster. Our sincere hope is that IJCCI, as a scholar community dedicated to the whole and healthy development of young people and their surrounding social systems, may play a part in shaping a better future. The pace of technological advances will only quicken in the coming decades, and we see IJCCI as a place for critical, rigorous, and optimistic scholarship to understand and envision the relationship between childhood and technology.

2. Background: Looking back

The initiation of CCI as a field of research stems from the 1960s [1–3], when pioneering researchers such as Seymour Papert, Edith Ackermann, Marvin Minsky, and Alan Kay explored the design of computer systems for children. In the 1990s, CCI research produced a steady flow of work stemming largely from the field of Human Computer Interaction. As a multidisciplinary research community CCI is directly connected with several research areas (e.g., psychology, learning sciences, interaction design, engineering, computer science and media studies). An increasing number of CCI related publications started to appear at a range of general HCI and learning conferences at the beginning of 2000s, this boosted the establishment of the International Conference on Interaction Design and Children (IDC) in 2002 [4].

During the last two decades, notable endeavors and contributions have significantly furthered CCI research and the development of a vibrant research community. In addition to the

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annual IDC conference and several neighboring conferences and journals (e.g., CHI, TEI, FabLearn, ToCHI) that systematically contribute to CCI research, representative collections of early works can also be found in the seminal volume edited by Druin [5], special issues focusing exclusively on CCI research (e.g., [6,7]) and books (e.g., [8,9]). During the last decade, IDC has been the center for CCI research with attendance numbers in the 200 to 400 range, a submission range of 150–200 papers and annual proceedings of approximately 50 articles (full papers and notes). Another notable contribution of the last decade in the CCI research comes from Juan Pablo Hourcade in 2015. Hourcade published a book called "Child-Computer Interaction", in this book Hourcade [2] focuses primarily on research published at the CHI and IDC conferences, and includes guidelines through the ten pillars of CCI namely: working in interdisciplinary teams, deeply engaging with stakeholders, evaluating impact over time, designing the ecology not just the technology, making it practical for children's reality, personalizing, being mindful of skill hierarchies, supporting creativity, augmenting human connections, and enabling open-ended, physical play.

In 2013, two of the initiators of the IDC conference series (and co-authors of this editorial), namely Panos Markopoulos and Janet C Read, led the establishment of IJCCI as a dedicated journal for CCI research. With the inception of IJCCI, its inaugural editorial provided a brief review of CCI landscape [1] and identified four future challenges for the CCI community. First, closing the gap between theory and design by developing models and guidelines that could guide the design of interactive artifacts for children. Second, further exploration of children's participation in CCI research (e.g., as social actors, as designers, as users). Third, the role of mobile and pervasive technologies, tangible, and embodied interaction and the opportunities these technologies offer for CCI application areas (e.g., play, learning, communication). Fourth, the penetration of social and cloud technologies in CCI (e.g., storytelling) and potential risks regarding children's privacy and security. Since then, CCI research has evolved significantly, however, those challenges are still important and relevant in furthering our knowledge about the phenomena surrounding the interaction between children and computational and communication technologies.

During the last years, we have seen research on Participatory Design (PD), tangibles, design, coding, making, learning and education, to appear as a driving force in CCI [3]. In addition, we have seen IJCCI special issues[1] focusing on children's roles, the gap between research and practice in CCI, designing for/with children with special abilities, coding and computational thinking, and special issues stemming from the CCI communities of IDC and FabLearn/MakeEd Europe. Over its eight years of existence, IJCCI is achieving its mission to accelerate developments around CCI research and to serve as a forum for communicating original, high-quality research. It is satisfying and rewarding to see IJCCI indexed in Scholar metrics[2] and ranked as an SJR first quartile journal (i.e., Q1) in both Education and HCI categories,[3] receiving significantly more citations per paper than several long-standing journals in Education and HCI. Although we recognize the that bibliometric indices can be reductionist, we believe the journal's upward trajectory[4] reflects the high quality of research produced by its community of scholars.

3. Challenges and opportunities

We (Michalis Giannakos and Mike Horn) are excited to take over as editors-in-chief, with renewed enthusiasm for maintaining the journal's high quality and growth. In this change of guard, our priorities are to continue to attract top-quality CCI papers, to maintain an enthusiastic "dream-team" editorial board, and to provide contributing authors with timely reviewer feedback. It is perhaps premature to describe any major changes in IJCCI, this is something we would like to discuss and shape together with the readership and the CCI community. However, in line with our priorities, we are taking following four actions:

- **Maintain an active Editorial Board with leading researchers in the field.** IJCCI's editorial board includes not only many seasoned veterans but also some younger researchers who have already made a mark on the field.[5] Our goal is to monitor IJCCI's development and balance the need for expertise across a variety of CCI research topics with experienced CCI researchers who can provide authors with insightful feedback and support the development of IJCCI.
- **Maintain a timely review process.** To keep IJCCI attractive and relevant to the changing publishing world, we have set a target for each phase of the review process aiming to reduce to just 10 weeks the average time an article is under review.
- **Increase the visibility of IJCCI by reinforcing natural ties with high-quality HCI and learning conferences.** This approach, which has been successfully adopted by other journals (the closed connection between the conference and the journal), will further support the CCI community to grow and strengthen its publication capabilities. We aspire to maintain the close collaboration with IDC and FabLearn Europe communities, but also develop connections with other relevant HCI and learning conferences (e.g., ICLS, CHI, TEI, EC-TEL, LAK).
- **Initiate special issues of interest to CCI.** The fourth direction we have already started working with is connected with the initiation of relevant special issues led by pioneering researchers on those thematic areas. Special issues on Ethics in CCI [10], Learning Analytics of Embodied Design [11], Review Articles in CCI Research [12] and Smart Toys [13] have already been established. Our goal is to have 4 high-quality special issues per year and we would welcome further suggestions from the CCI community.

We hope that these actions will contribute to the further development of IJCCI as a premier publication venue in the fields of HCI and learning. The most important asset of IJCCI is the vibrant international community and the tremendous level of volunteerism from community members. These community members include the authors, who are committed to conducting and presenting high-quality research; the reviewers, who provide constructive feedback on how to improve research and manuscript; and the IJCCI editorial board members and guest editors, who synthesize reviewers' feedback into coherent sets of recommendations and then follow up this work until it is ready to get published. Our pledge is to do our utmost to support the CCI research community and IJCCI's development, by appreciation and respect for the tremendous amount of volunteerism and dedication from the community members.

1 https://www.journals.elsevier.com/international-journal-of-child-computer-interaction/special-issues.

2 https://scholar.google.com/citations?hl=en&view_op=list_hcore&venue=ZkCOPViKaVAJ.2020.

3 https://www.scimagojr.com/journalsearch.php?q=21100228541&tip=sid&clean=0.

4 https://www.scopus.com/sourceid/21100228541.

5 https://www.journals.elsevier.com/international-journal-of-child-computer-interaction/editorial-board.

4. Avenues of future research

In the inaugural editorial to the first issue of IJCCI, the founding editors pointed out the fundamental challenges relating to CCI and the importance of CCI research when designing software and hardware for/with children. Looking to the future, it is as important now as when the journal started to continue the essential *child-centered perspective* and to welcome contributions from scholars in diverse scientific inquiries, bringing to bear different theoretical backgrounds and methodological practices. By embracing our nature of being a multi- and inter-disciplinary field we should focus on developing appropriate forms of rigor, that can help us to advance our community.

Today, the range of phenomena surrounding the interaction between children and computational and communication technologies that scholars in this field address is clearly much broader, as computing is embedded in almost every aspect of children's life. New and perhaps unforeseen behaviors and needs have emerged surrounding the design and use of technologies for children. The impact technology has on children's lives raises questions that are much bigger than our scholarly community alone, but also industrial and societal sectors such as information technology, entertainment, communication, health, education, and government. In view of these contemporary developments and in an attempt to complement the key challenges for the CCI community identified by the founding editors [1], we identify the following eight areas of research that will allow researchers and practitioners to position their work, as well as to nurture discussions about the future development of CCI.

- **Children's roles and participation.** Children's roles in technology design vary depending on the maturity of technology prototypes, the expected end-user of products (e.g., child as a primary or secondary user), and children's age and abilities. Those roles were initially described using three dimensions (i.e., the relationship to adults, the relationship to technology, and the goals for inquiry), and four initial roles for children in the design process have been defined (i.e., users, testers, informants and design partners) [14]. This distinction of roles has prevailed in the CCI research with further efforts to engage children even more intensively in the design process [15,16]. Advancing our understanding and the respective methodological processes on children's roles and participation, and furthering children's engagement in the design process, has always been at the top of the CCI research agenda. Keeping up in this research direction will provide a solid foundation for further development of the field and accelerating its progress.
- **CCI research methods, adopting and adapting.** CCI is a multidisciplinary scientific community that combines inputs and perspectives from multiple disciplines of research and practice, with the wider aim of understanding and envisioning the impact of technology on children and society [2]. By drawing on a wide range of research methods and practices, the field helps to highlight tensions as well as congruities between diverse perspectives. Future research needs to focus on appropriate adoption and adaptation of those research methods, by contextualizing them to CCI but also on developing appropriate forms of rigor, resulting in research methods that are both "credible" and relevant to CCI challenges. The journal can play a key role in the dissemination of methodological advances and to allow new generations of CCI researchers to build on the accumulated experience from the past.
- **Considering emerging technologies to support children.** The general trend to utilize emerging technologies and design applications that address end user's needs and interests has driven the development of interactive technologies in the field of HCI. A similar trend can also be observed in CCI with a focus on children's needs (compared to the adult end-use in the HCI). This general line of research will continue to grow and develop "technology-centered" solutions that often lead to "artifacts-centered" evaluations and knowledge. The journal can help compile lessons learnt and ambitions from the future in order to steer technological developments and make sure that technologies are appropriate and beneficial for children.
- **Supporting learning, sociability, healthcare, play and behavior change.** CCI research has been focusing on various "application areas" where it is common to have children as the end-user. The focus on these areas is motivated by both pragmatic and practical reasons (e.g., improving a new affordance or technology to support children's lives). Given that children will continue to be major users in those areas, it is important that future CCI research will remain engaging with experts from those disciplines (e.g., healthcare, communication, behavioral science) and facilitate a process of understanding differences and commonalities within the various domains.
- **Embracing emerging computational capabilities for children.** Children from medium to high-income countries have access to several ubiquitous technologies such as tablets, smartphones and wearables [17]. These technologies, thanks to their various affordances (e.g., multitouch technology, motion-based technology) are becoming accessible to very young children and are capable of sensing and processing data during child's interaction (e.g., location, locomotion, audio). As those ubiquitous "invisible" systems and their respective intelligence that is fueled from the produced data and the sophisticated Artificial Intelligence (AI) techniques evolve and used daily, several challenges and opportunities connected with these novel socio-technical realities and encompassed with unprecedented ethical and social concerns [18,19] require in-depth investigation and debate in the CCI community.
- **Responsible and Ethical CCI research.** Today's children are growing together with the pervasive devices that utilize data-driven interactions. Their perceptions for such technology as a part of their habitat are likely to be very different than those of adults [20]; moreover, their dispositions over the use of their personal data (e.g., voice and they use biometric recognition) might be different compared to adults. Therefore, those technological advancements pose fundamental questions on which technological futures we should be developing and/or how we face and mediate ethical issues and dilemmas when doing digital media and interactive research with and for children [10].
- **Bridging "artifact-centered research" with "theory construction".** Closing the gap between the theory and practice/design is a long-standing challenge in CCI [1]. Despite the fact that the majority of contemporary CCI research tend to follow the latest technological developments (e.g., papers exploring the application of new technology to the CCI domain) and producing "artifact-centered evaluations" [21], during the last years we have seen growing discussions and initiatives supporting the development of knowledge that goes "beyond an artifact" [22]. Such a line of work will allow the field to develop models, theories and guidelines that could guide the design of interactive artifacts for children beyond particular artifacts and accelerate the progress in our field.

- **Advancing literacies for children.** Recent years have seen an increasing interest in supporting the development of new literacies including media literacy and computational literacy among others in childhood. Contemporary educational and infrastructural developments, like CS for All,[6] ISTE's Standards for Students in Computational Thinking,[7] Computer Science Teachers Association's Concepts of Computational Thinking,[8] and the appearance of tools such as robotics, 3D printing, microprocessors, and intuitive programming languages posit that advancing literacies for children will continue to be a central thematic research area in CCI, with a direct impact to the IT industry and society.

These research strands must not be considered as directions that form research objectives in silos. Their interplay, contextualization and connections with fundamental theories could enable the formation of research questions and hypotheses and ultimately advance CCI knowledge base. To keep informing the field with evidence-based knowledge, coming from various methodologies, approaches and technologies, we highlight the need for strong empirical CCI research targeting improvements on those eight fronts that new technologies can contribute to the field of CCI. To this end, we call for strong research with multidisciplinary methodological and theoretical perspectives, ranging from quantitative to qualitative and mixed methods studies, and controlled experimentation to field observation; to advance on these eight major areas of research.

5. Importance and next steps

CCI research has never been as important as it is today, not only for the impact it has on children, families, and society at large, but also for to ameliorate issues of isolation, hardship, and loss imposed over recent months by the Pandemic. Recognizing that children as users deserve technologies, services, products and techniques that are designed for them, with their needs and abilities in mind, we clearly see the tremendous importance and impact of CCI research to the sustainable development of our societies.

For the near future, we are looking forward to publishing the forthcoming special issues. The first is connected with IDC 2020 and will put together a special volume with state-of-the-art works in the field [23]. While the second is connected with FabLearn Europe/MakeEd community and focuses on Computing, Design and Making in Education [24]. Contributions from these two special issues will start getting published soon and we expect to have the two special volumes completed by the end of the year.

For the next year, we have lined-up four exciting special issues and would like to invite you to submit your contribution (to the ones that are still accepting submissions). The four special issues we have lined-up are (1) on Review Articles in CCI Research (expected publication: 1st quarter of 2021); (2) on Smart Toys, Robots and other Smart Tangibles for Children (submission deadline: October 31, 2020; expected publication: 2nd quarter of 2021); (3) on Learning Analytics of Embodied Design: Enhancing Synergy (submission deadline: November 1, 2020; expected publication: 3rd quarter of 2021); and on Ethics in CCI (submission deadline: December 21, 2020; expected publication: 4th quarter of 2021). At the same time, we are also working in initiating special issues on PD in CCI, Child–Robot Interaction, Coding and AI/ML literacy in childhood and other interesting thematic areas.

6. Conclusions

We will close our inaugural editorial by asking a question to CCI researchers: How would you like to see IJCCI growing? As a journal contributor and reader, and member of the CCI research community, this is designed to be your "home" journal. We would like to listen to ideas and suggestions, so that, together, we can shape a bright future and keep IJCCI as the premier journal in CCI research, and a respectable and leading journal in HCI and learning research.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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